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galleries as usual, while others dropped them near the mouth or door. The evening was quite cool and Mr. McCook's impression was that the ants who dropped the pellets within or just outside of the doors were probably caused to do so by the sense of cold with which they were met. Feeling the cold air as they approached the gate, instead of pushing out, they stopped, dropped the pellet, and turned back. Thus the grains accumulated, giving the appearance of an intentional closing. Through the doors which were nearly closed an ant head and antennæ could occasionally be seen peeping forth.

May 27.

The President, Dr. Ruschenberger, in the chair.

Thirty-four persons present.

Charles H. Pennypacker and Robert S. Davis were elected members.

June 3.

The President, Dr. Ruschenberger, in the chair.

Twenty-one members present.

June 10.

The President, Dr. Ruschenberger, in the chair.

Fifteen persons present.

The deaths of Wm. W. Longstreth and F. F. Maury, M.D., members, were announced.

Combats and Nidification of the Pavement Ant, Tetramorium Cæspitum.—Mr. McCook exhibited a large glass jar containing a nest of this ant made by captives taken from a city garden. During the month of May immense numbers of this species have been seen along our sidewalks, in yards and gardens, engaged in combat. From one of these masses of struggling insects, three large groups were taken and placed in separate jars. The transfer had no visible effect in separating the combatants. Into one jar (No. 1) a pellet saturated in cologne was introduced. Instantly, as in the case of experiments previously reported,[1] the combatants separated, and buried themselves pell-mell in the earth. Not an ant remained above the surface. The pellet was removed, and the jar thoroughly aired; whereupon the ants speedily began to reappear. They seemed to be confused somewhat by the fumes of the cologne, but soon began to dig galleries. Only two pairs resumed the fight, and these shortly unclasped mandibles. There was no resumption of hostilities thereafter, and the two parties appeared to interblend and fraternize completely.

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[1] Mode of Recognition among Ants, Proceed. Acad. Nat. Sci., p. 15, 1878.

In the second jar (No. 2), the one exhibited, the ants were left undisturbed. The battle continued for two days. It was waged over the entire surface of the earth within the jar. Every clod and other elevation was the seat of one or more duels, for, as a general rule, the fight was waged by twos, but also frequently by threes. The duelists seized each other by the head, frequently interclasping mandibles, and pulling backward or swaying back and forth. Again, one would have her antagonist grasped by the face above the mandibles, which placed the latter at a great disadvantage. In such cases, and in others also, both ants would be reared upon the hind and middle legs, with abdomens turned under, and stinging organs thrust out. When three ants were battling in one group, the third commonly held her opponent by a leg, or had seized her by the abdomen or thorax. Occasionally the exertions of the combatants caused them to roll upon the ground.

At the close of the first day, numbers had retired from the conflict and perched upon the sides of the jar. On the third day the battle had ceased, and the ants were engaged in excavating galleries. Whether the survivors were all of one party could not be determined, except inferentially by the following experiment.

The jar which had been fumed with cologne (No. 1) was introduced into jar No. 2, which was large enough to admit it. The ants in No. 1, who had been hostile, were then working together harmoniously. They, in turn, soon interblended with those in No. 2, all thus composing one apparently united formicary. It thus appears, whatever may have been the cause of the combat, that, first, the influence of the cologne fumes completely pacified and united the contending parties; and, second, that the previous hostility was no barrier to their forming one harmonious nest. Subsequently the jar was placed uncovered in the open air and was abandoned by all but a few of the ants within two days.

There were many dead bodies, which were gathered in one large heap, that each day was increased by the death of the (probably) injured. This "graveyard" was subsequently changed to another spot, but the dead were kept together as they now are.

In at least one case noted the cause of the ant battle seemed quite clear. The warring insects were spread thickly over a surface of nearly a square foot of the sidewalk, quite near the curbstone. The centre of this struggling mass was a quantity of fatty matter which had been thrown on and around the seams of the bricks through which a large formicary had made its gates. From the battle field a column of ants, three or four lines deep, stretched along a depression caused by a shallow surface drain to a second nest just under a gate that led through a wall into the house-yard. Evidently the ants from the curb formicary had fallen upon the unctuous treasures which had dropped by their doors, but had been disturbed in their "feast of fat things" by stragglers from the gate nest. The stragglers were attacked; others came, and in time were attacked; messengers ran to the gate nest for reinforcements; fresh squadrons issued from the curb colony, and thus the battle grew. When it was first seen a single line of ants was stretched from battle ground to gate, and a double line from gate to battle field. The ants in these columns were in the utmost agitation. As they hurried along, fairly a-quiver with excitement, they suggested strongly the outward mien and behavior of human beings running to and from a fire, a riot, or a fight. Mr. McCook was not able to watch the issue of this ant battle, but had no doubt that the above is the true theory of its origin. It is probable that many similar conflicts originate in like rivalries for the possession of food

The system of galleries excavated by these insects is precisely like that of most other mason ants. It is a network of galleries for the most part from one-sixteenth to one-eighth inch wide, but with frequent greatly widened portions. The "meshes" or solid interspaces vary much in size. The galleries were made against the inner surface of the jar, and thus are entirely visible. The ants seemed to have no objection to working in the light. The principal galleries have a tendency more or less regular to the vertical and horizontal, but the impression was made by the mode of operations that the workers were rather influenced by some accidental feature or quality of the soil, than directed by any intelligent plan, in laying out and driving the galleries. The behavior of the ants gave to a human observer the impression of unconscious action, not of forethought. On the contrary, a glance at the series of galleries, as thus far completed, shows an arrangement admirably suited for the purposes of a nest. The cross-galleries are all inclined at various degrees of inclination, leading into each other and out of the surface-gates, by grades which afford easy passage. There is thus a mechanical advantage in the very irregularity of the arrangement. It is not improbable, to say the least, that the muscular system of the ant is so constructed that she unconsciously takes the line of least action in her work, as do human beings and lower animals when climbing the side of a hill, or moving across irregular surfaces. The thorough interlacing of the galleries affords easy intercommunication throughout the nest. There is also an evident convergence of the cross galleries at several points upon vertical galleries which are much widened as though to provide for the convenient movements of increased numbers.

The structure of a nest in natural site is obviously more difficult to study. For the sake of comparison, one was taken which was located on the edge of a brick walk. The walk was separated from the grass-plat by a line of bricks set on edge. Several of these and the adjoining flat bricks were removed, thus quite exposing the fomicary to the depth in parts of four inches. The side of the grass-plat against which the bricks had pressed was pierced by many openings, one-quarter of an inch or more in diameter, leading for the most part directly into ovoid chambers whose longest diameters were from three-fourths of an inch to one inch in length. One of the largest of these was close to the surface just beneath the grass roots, and was filled with naked larvæ of worker ants, most of which were white, a few yellow. These chambers had interior openings extending into the earth. They were united together by galleries, where their boundaries did not interblend. There was an opening directly upward into the grass, but the main avenue for the carriage of excavated earth led downward to the lower edge of the brick, then diagonally upward through the earthen seam of that and the next brick, debouching at the surface and upon the pavement. Openings downward communicated with this avenue, as did also a broad (three-eighths inch) winding track, which followed the under surface of the brick its entire length, and beyond. These avenues presented the characteristics of those in the artificial nest, but were larger and not so numerous. The large larvæ of several queens were found in the lower avenues.

The behavior of the ants placed in jar No. 3 was like that of those in No. 2, *i. e*, the fighting soon ceased, and the work of gallery digging began. Here, also, it could not be determined whether the survivors were of one party or of both, but the latter was inferred in view of the experiment which showed the interblending of the harmonized hostiles of No. 1 with the survivors of No. 2. The galleries here were not made against the surface of the glass as in No. 2, but were confined apparently to the interior of the earth, which they must have quite honey-combed, as shown by the quantity of pellets brought up, and by the numerous openings upon the surface.

In this connection Mr. McCook referred to the economy in nature of ants by contributing to the fertilization of the earth. A comparison between the formicaries of various species shows that all the mason ants substantially agree in (at least) subterraneous nidification. The example presented of the underground work of *Tetramorium* will give some idea of the manner in which the earth may be excavated by a single colony. In a portion of the exposed surface, which presented less rather than more of the average amount of excavation, the gallery surface was measured. In a space of three square inches there were (approximately) one and nine-sixteenths square inches of gallery surface, or about onehalf of the measured space. The galleries were in depth fully one-eighth of an inch. This will give a rude notion of the extent to which the underground space occupied by a single colony is excavated.

Another estimate was made of the quantity of earth thrown out of a nest in the two days succeeding a heavy rain. The excavations brought up from the seam of a brick that faced a grass plat, and which were spread along a distance of eight inches, were collected and measured. The result showed a solid contents of six cubic inches. This was only a part of the work of a formicary in the time specified, during only a part of which the ants were engaged in transporting pellets.

The other factor in the calculation is the number of ants of various species spread over any given surface of the earth. Accuracy of count would be quite impossible; but if one will take pains to observe the number of nests which may be seen in nearly every open tract of country, he will be surprised at its vastness. In some such rough observations, made in the open field, Mr. McCook had concluded that it would be scarcely possible to dig within any square foot of surface without uncovering the formicary of some, often of several, species of ants. There is of course a difference in this respect between soils and sections; but the fact is constant that innumerable myriads of ants are everywhere located and operating as above described. As results of such labor, *first*, the ground is pulverized and brought in great quantities to the surface, thus making good top soil for the growth of vegetation. The nest by which these remarks were illustrated shows that, insignificant in size as these insects are, the labors of countless hosts through many years are by no means insignificant in this shifting of the soil. *Second*, the aëration of the soil, so needful for its productiveness, is thus largely promoted. *Third*, the system of "pores," established by the galleries which everywhere perforate the ground, affords, on the one hand, free entrace for the rains into the earth, and, on the other hand, a series of tubes through which, by capillary attraction, the moisture may ascend to the roots of plants. In this geographical province (Philadelphia) perhaps the most numerous species, and therefore the most effective toward the above results, are *T. cæspitum* and *Lasius flavus*, both small species, the largest workers being little more than one-eighth of an inch in length.

The fate of the ants during the late heavy June rains had somewhat occupied Mr. McCook's attention. Where do the little creatures find refuge? or do they find any sheltered spot within their nest? It would seem that the health and safety of the larvæ at least must require some protection from the water. But he could not satisfy himself that *Tetramorium* has any such shelters. The pellets of soil brought up after the rains were all damp, and had evidently been reached by the water. The opened formicary above referred to showed that it had been penetrated, as far as examined, by the water, as the soil was thoroughly soaked through. The numerous galleries must give more ready access to the rains within formicary bounds than elsewhere. The points are of much interest, and are still under examination, but the following suggestions were made: First, the peculiar arrangement of the galleries and chambers indicates that the least exposed portion of the nest is that near the surface, in the parts which do not communicate directly with the same. The main entrance and exit being removed from this, and penetrating downward and beneath it, would cause a drainage which, carrying off the first flood, would leave the upper chambers comparatively safe until the water should fill up the lower spaces and back up to the surface rooms. Second, it is probable that the galleries which penetrate downwards may serve the purpose of drainage downward. In heavy rains, however, neither of the above arrangements would seem to afford ample protection. Third, it is therefore probable, and observation and some experiments[1] appear to point in this direction, that the ants themselves (if not the larvæ) can endure a submersion more or less prolonged with comparative safety.

Honey Glands on Catalpa Leaves.—Mr. J. A. RYDER stated at the meeting of the Botanical Section that he had recently observed the presence of a number of large nectar-secreting glands on the under side of the leaves of the common *Catalpa bignonioides*. These glands are situated in the axils of the veins of the leaf, *i. e.*, where the lateral veins join the midrib. Those nearest the insertion of the petiole are largest, whilst toward the apex of the leaf they are smaller. The glandular areas, extending over a considerable axillary space as well as to some extent over the sides of the veins, are without hairs, the place of the latter being taken by large biscuit-shaped, sub-circular glandular bodies attached to the surface of the leaf much like a button to a piece of cloth, and projecting above the circumjacent epidermis, though at the point where the gland is attached the epidermis is depressed. The appearance is not much unlike that of the circumvallate papillæ of the base of the human tongue. The glands seemed to be modified hairs, and in thin vertical sections are seen to be composed of columnar cells arranged around a cavity. The nectar observed in a few instances was perceptibly sweet to the taste, and thrown out in sufficient quantity to be seen as small clear drops in the axils of the veins. Ants of both red and black species were seen feeding upon this sweet liquid with great avidity.

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[1] See a brief paper on the Vital Power of Insects, Proc. Acad. Nat. Sci. of Phila., 1877, p. 134.